

*Shelve in stacks**S.B.T.*

Highway Safety Literature

... A SEMI-MONTHLY ABSTRACT JOURNAL

AVAILABILITY OF DOCUMENTS

Documents listed in **Highway Safety Literature** are **not** available from the National Highway Traffic Safety Administration. They must be ordered from the sources indicated on the citations, usually at cost. Ordering information for each of the sources is listed below.

NTIS: National Technical Information Service, Springfield, Va. 22151. **Order by title and accession number:** PB, AD, or HS.

GPO: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. **Give corporate author, title, personal author, and report number.**

Corporate author: Contact corporate author.

Reference copy only: Consult your librarian.

See serial citation: Obtain through normal loan or purchase.

SAE: Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001. **Order by title and SAE report numbers.**

HRB: Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

Material directly related to Highway and/or Motor Vehicle Safety is solicited for inclusion in Highway Safety Literature. Topics must fall within the scope of the mission of the National Highway Traffic Safety Administration. Submit material, together with a written statement of approval for publication to:

Office of Administrative Services (N48-50)

National Highway Traffic

Safety Administration

400 7th Street, S.W.

Washington, D.C. 20590

Please indicate availability source and price for the material.

Special notice: Material published in HSL is intended only for information. References to brand names, equipment models or companies does not imply endorsement by the NHTSA or the U.S. Department of Transportation.

SAMPLE ENTRIES

JOURNAL ENTRY

Title of Document { **SYNTHESIS OF CASE LAW JURISPRUDENCE RELATING TO WET-WEATHER HIGHWAY CONDITIONS**

Journal Citation → Highway Research Record n 376 p29-36 (1971)

Author(s) → D. C. Oliver 1971

Search Terms { Descriptors: *Liability, *Negligence, *Accident responsibility, *Legal responsibility, *Wet road conditions, *Court decisions, *State government, *Skidding accidents, *Warning signs, *Highway maintenance, *Litigation, *Icy road conditions.

Abstract { The extant case law on legal liability for accidents occurring on icy and wet highways has established three central areas and one subarea in the jurisprudence of maintenance liability. These areas are compliance with general duties in order to escape liability; damages resulting from noncompliance (negligence); contributory negligence as a bar to recovery; and advisory signing as a technique in meeting general duties. Court decisions covering these four areas are presented.

NHTSA Accession Number → HS-012 289

*Subject heading in Subject Index

CONTRACT REPORT

EQUIPMENT AND PROCEDURES FOR MEASURING GLARE FOR MOTOR VEHICLES. FINAL REPORT

Corporate author → Teledyne Brown Engineering

Availability → N. E. Chatterton J. D. Hayes E. W. George 1972 102p
Contract DOT-HS-089-1-139
NTIS

Descriptors: *Glare, *Glare reduction, *Visual perception, *Photometers, *Luminance, *Hydraulic equipment, *Central vision, *Field of view, *Backgrounds, *Contrast, *Light conditions, *Brightness, *Test facilities, *Test equipment, *Vehicle safety standards, *Simulators, *Light, *Reflectance, *Measuring instruments,

A procedure and description of equipment for measuring glare from a driver's own vehicle are presented. The procedures are based on a disability glare theory as applied to foveal vision. Two pieces of apparatus were constructed to provide the measurement capability. One of them simulates diffuse sky glare and the other simulates direct solar glare. Methods of combining data from these measurements are presented along with scaling laws selected to provide a value for glare as it would be under natural daylight conditions. A standard for allowable glare levels from the vehicle is developed which is independent of the measurement procedure. Test results from a passenger car are presented and compared with this standard. Recommendations for improvements to the apparatus and additional research requirements for improvement to the theory are made.

HS-800 731

*Subject heading in Subject Index

1A. Emergency Services

AMBULANCE DESIGN CRITERIA. REV. ED.

National Hwy. Traf. Safety Administration
For primary bibliographic entry see Fld. 5D.
HS-820 264

1B. Injuries

DATA RELEVANT TO THE PERFORMANCE OF HEAD RESTRAINTS IN COLLISIONS

National Hwy. Traf. Safety Administration
For primary bibliographic entry see Fld. 5N.
HS-820 259

1C. Investigation And Records

COMPARISON OF ACCIDENTS AND ILLUMINATION

For primary bibliographic entry see Fld. 2E.
HS-012 935

STUDED TIRE EFFECTS ON PAVEMENTS AND TRAFFIC SAFETY IN MINNESOTA

For primary bibliographic entry see Fld. 5V.
HS-012 938

MULTIDISCIPLINARY ACCIDENT INVESTIGATION REPORT AUTOMATION. VOL. 4. UNIVARIATE FREQUENCY DISTRIBUTIONS. FINAL REPORT

Michigan Univ. Hwy. Safety Res. Inst.
HSRI-SA-72-1-4
Report for Feb 1971-Oct 1972.
NTIS

*Automated accident records, *Electronic accident analysis, *Coding systems, *Data processing, *Statistical analysis, *Accident factors, *Accident investigation, *Accident report forms, *Accident reports, *Vehicle characteristics, *Injury severity, *Damage severity, *Automobile models, *Driver characteristics, *Injuries, *Restraint system usage, *Passenger characteristics, *Multidisciplinary teams,

Code value definitions and univariate descriptive statistics for the entire Multidisciplinary Accident Investigation (MDAI) automated report file are presented. Accident data recorded on the Collision Performance and Injury Report (CPIR), Revision 3 have been built into three MDAI files: vehicle, occupant, and injury. For each of 1,092 MDAI investigated case vehicles on file, 829 variables have been processed. Data on 1,854 MDAI case vehicle occupants and 7,710 occupant injuries are also in computer storage. Annotated accident report forms are used as a codebook to define the code values for each variable. Univariate frequency distributions are used to statistically describe the file contents for each numeric variable.
HS-800 770

ACCIDENT INVESTIGATION TECHNICIAN INSTRUCTOR TRAINING INSTITUTE. VOL. 1. FINAL REPORT

Center for Vocational and Technical Education
R. D. Daugherty A. C. Hayes S. R. Orletsky

*Instructor training, *Accident investigation training, *Curricula, *Manpower utilization, *Planning, *Program evaluation, *Questionnaires,

Seventy-five professional instructors participated in workshops for the development and implementation of curricula for training accident investigation technicians. Literature on highway safety, accident investigation, manpower, and curriculum development was reviewed. A non-tested curriculum package was produced that consisted of a course guide, instructor's lesson plan booklet, and student resource study guide. Accident investigation is in a state of rapid change and lacks previous analysis of the tasks required for entry-level accident investigation technicians, both of which caused difficulty in the development of the curricula. There exists considerable difficulty in training instructors to teach a non-law enforcement accident investigation technician when the background of the instructors is based upon law enforcement practices and experience. It was concluded that the dual purpose project of training instructors and developing curricula is complementary and useful as a technique for curriculum development.
HS-800 824

FATAL CRASH REDUCTION PROGRAM. A DEMONSTRATION PROJECT

National Hwy. Traf. Safety Administration

NHTSA

*Accident prevention, *Fatality prevention, *Law enforcement effect on accident rates, *Michigan, *Texas, *Safety program effectiveness, *Benefit cost analysis, *Fatality rates, *Accident rates, *Traffic law enforcement, *Patrolling, *Statistical analysis, *T test, *Graphs, *Demonstration projects,

The Fatal Crash Reduction Program (FCRP) was developed to demonstrate and evaluate the effectiveness of a concentrated traffic law enforcement effort within a given geographical area and to measure its influence on the number of fatal accidents and deaths occurring within that area. Michigan and Texas participated in the program. In Michigan, the FCRP operated from August through December, 1972. Five counties were covered: Cass, Eaton, Hillsdale, St. Clair, and Tuscola. The total program cost was \$285,000. The FCRP was operational in Texas from September through December 1972. Harris County was the experimental area covered. Total cost for the program was \$255,000. In Michigan, 42 fatal accidents and 59 fatalities were prevented, and the societal cost saving was \$11,800,000 with a benefit cost ratio of 41:4.4. Ten fatal accidents and 14 fatalities were prevented in Texas. The societal cost savings amounted to \$2,800,000 with a benefit cost ratio of 11:1.
HS-820 254

2. HIGHWAY SAFETY

2D. Design And Construction

AN AUTOMATIC DRIVING SYSTEM OF AUTOMOBILES BY GUIDANCE CABLES

Japan Automobiles Res. Inst., Inc.
For primary bibliographic entry see Fld. 5D.
HS-012 914

STUDDIED TIRE EFFECTS ON PAVEMENTS AND TRAFFIC SAFETY IN MINNESOTA

For primary bibliographic entry see Fld. 5V.
HS-012 938

2E. Lighting

FREEWAY ACCIDENTS AND ILLUMINATION

P. C. Box

Sponsored by Illuminating Engineering Res. Inst. and Automotive Safety Foundation.

See serial citation

*Highway lighting, *Day vs night accidents, *Freeways, *Light conditions caused accidents, *Accident rates, *Brightness, *Luminaires, *Lighting tests, *Lamp tests, *Chi square test, *T test, *Accident statistics, *Interchanges, *Vehicle light pole collisions, *Benefit cost analysis,

The time during which ambient light conditions are such that typical roadway illumination would have an effect is from 15 minutes after sunset to 15 minutes before sunrise. Lighted freeways have lower (better) night-day accident ratios than unlighted ones. The lighted freeways with the lowest illumination, averaging 0.6 horizontal footcandles (HFC) maintained, have the best accident ratio. This corresponds to an initial illumination design level of about 1.0 HFC. There is wide variation in average illumination between adjacent pairs of luminaires along specific freeway sections. This is a result of differences in individual lamp output. The variations of HFC averages and uniformity are so great as to cast doubt on the real value of these elements in lighting design calculations.

HS-012 934

COMPARISON OF ACCIDENTS AND ILLUMINATION

P. C. Box

See serial citation

*Street lighting, *Accident factors, *Accident costs, *Syracuse (N.Y.), *Day vs night accidents, *Benefit cost analysis, *Accident rates, *Accident prevention, *Land usage, *Highway characteristics, *Brightness,

The night-day ratios of the number of accidents in Syracuse, New York in 1967 and the accident costs were calculated and related to the illumination of each study section. Streets with little or no illumination had substantially higher night-day accident ratios and accident cost ratios than the average for all streets in their respective groups. Streets with extremely high illumination levels also tended to have night-day accident and accident cost ratios that were above the average for each group. The type of street appeared to be more of a factor in accident-illumination relations than the type of abutting land use. The methodology developed during the project is felt to represent a major contribution to the techniques in making such studies.

HS-012 935

2G. Meteorological Conditions

MEASURED STATISTICAL CHARACTERISTICS OF AUTOMOTIVE IGNITION NOISE

General Motors Corp.

R. M. StorwickD. C. SchlickH. P. Hsu SAE-730133

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Engine noise, *Acoustic measurement, *Sound intensity, *Polarization, *Communication systems, *Frequencies, *Data acquisition, *Instrumentation, *Weibull density functions, *Rayleigh scattering, *Electromagnetic interference,

Noise produced by automotive ignition systems can deteriorate the performance of nearby communication systems. An important step toward alleviating this difficulty is to characterize the ignition noise. Measurements have been made of the noise peak amplitude distribution of a number of identically equipped vehicles over a fixed period of time. Both vertical and horizontal polarizations were used, and measurements were made at two frequencies, 145 and 230 MHz. These statistics were then compared to various probability distributions to attempt to characterize the amplitude distribution of the noise. The distributions studied were the log-normal, the exponential, the Rayleigh, and the Weibull distributions. The best fit was provided by the Weibull distribution. The parameters of the best fitting distribution are primarily a function of the antenna's polarization, with frequency having only a minor effect.

HS-012 908

PROCEDURES FOR ESTIMATING HIGHWAY USER COSTS, AIR POLLUTION, AND NOISE EFFECTS

Stanford Res. Inst.

For primary bibliographic entry see Fld. 2I.

HS-012 939

NOISE PRODUCED BY UNSTEADY EXHAUST EFFLUX FROM AN INTERNAL COMBUSTION ENGINE

Queen's Univ. of Belfast (Northern Ireland)

G. P. BlairS. W. Coates SAE-730160

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973. Sponsored by Ford of Europe, Inc.
SAE

*Exhaust noise, *Internal combustion engines, *Acoustic measurement, *Sound intensity, *Exhaust pipes, *Unsteady state, *Aerodynamics, *Test equipment, *Photography, *Flow, *Radiation, *Waves, *Pressure, *Spectral analysis, *Mathematical analysis, *Reflection, *Engine speeds, *Simulation models,

From a theoretical analysis of the unsteady efflux from the open end of a simulated reciprocating internal combustion engine exhaust system a prediction of overall and one-third octave sound pressure levels in space, due to this gas flow, is produced. The predictions are compared with measured levels and show a high degree of correlation.

HS-012 950

2H. Police Traffic Services

REPRESSIE EN VERKEERSVEILIGHEID (REPRESSION AND ROAD SAFETY)

For primary bibliographic entry see Fld. 3D.

HS-012 930

**FATAL CRASH REDUCTION PROGRAM. A
DEMONSTRATION PROJECT**

National Hwy. Traf. Safety Administration
or primary bibliographic entry see Fld. 1C.
S-820 254

. Traffic Control

**PROCEDURES FOR ESTIMATING HIGHWAY USER
COSTS, AIR POLLUTION, AND NOISE EFFECTS**

anford Res. Inst.
A. Curry D. G. Anderson NCHRP-133
sponsored by the American Assoc. of State Hwy. Officials in
cooperation with the Federal Hwy. Administration.
RB \$5.60

benefit cost analysis, *Air pollution effects, *Traffic noise,
travel time costs, *Accident costs, *Vehicle operating costs,
traffic capacity, *Traffic flow, *Transportation networks,
day of week, *Time of day, *Peak hour traffic, *Traffic
volume, *Queueing, *Traffic density, *Waiting time, *Idling,
exhaust emission measurement, *Exhaust emissions,
acoustic measurement, *Sound intensity, *Accident severity,
accident rates, *Origin and destination studies, *Road curves,
freeways, *Rural highways, *Vehicle classification, *Speed
ranges, *Highway maintenance, *Flow charts, *Manuals,
road grades,

This manual contains worksheets of procedures for determining
annual vehicle operating cost and travel time per highway section
for peak and off-peak periods by defining traffic capacity,
estimating peak and off-peak hourly traffic demand, and com-
puting demand/capacity ratios; analyzing congested traffic
queueing for sections and intersections in which demand ex-
ceeds capacity; obtaining unit vehicle running costs and travel
time as a function of the volume to capacity ratio; adding the
effects of grades, curves, and stops; and multiplying user cost
and time by the roadway section length and number of vehicles.
A method of estimating the effects of air and noise pollution as-
sociated with existing or proposed highway facilities under dif-
ferent levels of traffic is presented. Procedures for determining
accident costs and consumers' surplus, and a benefit cost anal-
ysis are included.
S-012 939

HUMAN FACTORS

**ACCIDENT INVESTIGATION TECHNICIAN
INSTRUCTOR TRAINING INSTITUTE. VOL. 1. FINAL
REPORT**

Center for Vocational and Technical Education
or primary bibliographic entry see Fld. 1C.
S-800 824

A. Alcohol

**ALCOHOL-INDUCED DEGRADATION OF
PERFORMANCE ON SIMULATED DRIVING TASKS**

Cornell Aeronautical Lab., Inc.
C. Sugarman C. P. Cozad A. Zavala SAE-730099
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973.

*Driver performance, *Alcohol effects, *Driving simulators,
*Driver intoxication, *Driving simulation, *Driver tests,
*Phystester, *Blood alcohol levels, *Breathalyzers, *Motiva-
tion, *Correlation analysis, *Driver reaction time, *Drinking
drivers,

Using the Cornell Aeronautical Laboratory Driving Simulator,
performance on position maintenance (lane-keeping), speed
maintenance, and reaction time was measured for 159 subjects
as they passed through various levels of intoxication over a
seven hour period. Using normalized scores for each individual
subject to correct for idiosyncratic extreme behaviors, signifi-
cant correlations were found between Breathalyzer readings
and performance on each of the simulated driving tasks. Signifi-
cant correlations were also found between each pair of simu-
lated driving task measures.
HS-012 924

**SOLID-STATE BREATH ALCOHOL VEHICLE
INTERLOCK SYSTEM**

Environmental Metrology Corp.
V. R. Brown G. R. Jindal E. Jo SAE-730097
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973.
SAE

*Alcohol breath tests, *Alcohol detection and interlock
systems, *Blood alcohol levels, *Driver intoxication, *Sensors,

Most modern breath alcohol analyzers are based on wet chemical
colorimetry techniques. Work based on solid-state sensor
technology, which accepts alveolar breath samples only is out-
lined. A device that prevents legally intoxicated persons from
interlocking the ignition system and operating a motor vehicle
when a breath alcohol level exceeds the preset level is
described. The device automatically analyzes the candidate
operator's breath without requiring him to perform any opera-
tion other than normal breathing.
HS-012 926

**A CRITICAL TRACKING TASK AS AN ALCOHOL
INTERLOCK SYSTEM**

General Motors Corp.
J. A. Tennant R. R. Thompson SAE-730095
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973.
SAE

*Alcohol detection and interlock systems, *Driver evaluation
devices, *Tracking, *Driver performance, *Driver intoxication,
*Alcohol effects, *Driver tests, *Blood alcohol levels, *Oscil-
loscopes, *Design of experiments, *Mathematical models,
*Learning rates, *Laboratory tests,

A compensatory tracking task requiring the operator to stabilize
the output of an unstable system whose level of instability in-
creases monotonically up to the critical point of loss of control
is evaluated for its potential to discriminate between sober and
intoxicated performances. Quantification of the results obtained
in a laboratory controlled environment indicates that intox-
icated failure rates of 50% for blood alcohol concentrations
(BAC's) at or above 0.1% and 75% for BAC's at or above
0.14% can be attained with no sober failure rates. The imple-

Field 3—HUMAN FACTORS

Group 3A—Alcohol

critical performance limits are anticipated for the mechanized automotive units because of the introduction of larger hardware and neuromuscular lags. Whether such degradation in performance would reduce the effectiveness of the device or not will be determined in a continuing program.

HS-012 927

ALCOHOL AND DRUG IMPAIRMENT OF THE DRIVER

California Univ. Inst. of Transp. and Traf. Engineering
H. Moskowitz SAE-730094

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Alcohol effects, *Drinking drivers, *Marijuana, *Drug effects, *Driver performance, *Attention lapses, *Blood alcohol levels, *Visual degradation, *Tracking, *Driving task analysis, *Driving simulators, *Auditory perception, *Motion perception, *Visual perception, *Visual acuity, *Dark adaptation, *Loading (operator performance),

Alcohol impairment of driving skills appears to be due to the information processing demands of a divided attention task. Driving is characterized as a divided attention skill involving: compensatory tracking and search-and-recognition for environmental signals. There is scant epidemiological evidence regarding marijuana effects on driving, but laboratory data are reported. Alcohol and marijuana effects differ, and it is concluded that effects of marijuana on performance are not related to division of attention and information processing rate. It is suggested that marijuana is less dangerous to the driving tasks than is alcohol, for the dose levels tested. It is possible, that marijuana causes brief dropouts of attention. However, such speculation must be tested before final conclusions regarding the possible dangers of marijuana to driving can be determined.

HS-012 928

ALCOHOL IMPAIRMENT DETECTION BY THE PHYSTER-ESTER-EVALUATION PROGRAM SUMMARY

General Motors Corp.

T. O. JonesJ. A. Tennant SAE-730093

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973. For another version of this report see HS-012 869.

SAE

*Phytester, *Alcohol detection and interlock systems, *Driver performance, *Safety device effectiveness, *Manual performance, *Alcohol effects, *Driver intoxication, *Driver physiological test devices, *Driver tests, *Blood alcohol levels, *Learning rates, *Age factors, *Sex factors, *Alcohol usage, *Driving simulators, *Intelligence, *Benefit cost analysis, *Consumer acceptance, *Correlation analysis, *Histograms, *Drinking drivers,

The Phytester, an ignition interlock system based on a predriving performance test, is evaluated. Results and observations from programs conducted by General Motors and other independent organizations are analyzed. The sensitivity of the psychomotor task offered by the Phytester to blood alcohol

HSL 73, No. 15

shown to be significantly correlated with blood alcohol concentration and with performance on simulated driving tasks. The Phytester is shown to be capable of discriminating between sober and intoxicated individuals, the intoxicated rejection rate being dependent on the magnitude of the acceptable sober rejection rate.

HS-012 929

3D. Driver Behavior

THE HEART RATE VARIABILITY CORRELATES OF SPONTANEOUS DROWSINESS ONSET

Duke Univ.

M. R. VolowC. W. Erwin SAE-730124

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973. Sponsored by General Motors Corp.

SAE

*Driver fatigue, *Heart rate, *Biomedical monitoring, *Electroencephalography, *Statistical analysis, *Drowsiness,

This experiment is one phase in the systematic evaluation of the reliability of heart rate variability (HRV) as a driver alertness indicator. Nine subjects became spontaneously drowsy in a passive laboratory situation, while heart rate (HR), electroencephalogram, and other physiologic measurements were recorded for one hour. Beat-to-beat heart activity in 40 s of waking record was compared with heart activity in 40 s of adjacent drowsy record, using electrographic definitions of waking and drowsy (transitional) states. Of three descriptors of heart activity, HRV only as measured by the mean square of HR, showed an inverse, but marginally significant and unreliable relationship to drowsiness onset. Neither HR nor HRV measured by mean square of successive differences of HR showed any relationship to drowsiness onset at all. It was concluded that HRV is not a reliable predictor of spontaneous drowsiness onset in the passive laboratory situation.

HS-012 916

DROWSINESS AND DRIVING IN A MIDDLE AGED POPULATION

Duke Univ. Medical Center

D. GianturcoD. RammW. Erwin SAE-730123

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Middle aged drivers, *Aged drivers, *Attention lapses, *Driver fatigue, *Age factor in driving, *Driver psychological tests, *Driver performance, *Driver personality, *Test volunteers, *Sex factor in driving, *Vision age changes, *Visual acuity, *Driver physical fitness, *Driver mental fitness, *Driver mileage, *Trip length, *Drowsiness,

Questionnaire results indicated that the incidence of drivers aged 45-70 admitting drowsiness while driving is high. This appears related to maleness, yearly mileage logged, and long trip driving. Cattell personality testing revealed no consistent group of personality traits which correlates with getting drowsy. Subjects who handled drowsiness especially poorly (that is, falling asleep) were characterized by emotionality, a tendency to worry, give up, and evade responsibilities. Many physical factors

PSYCHOPHYSIOLOGIC INDICES OF DROWSINESS

Duke Univ. Medical Center
C. W. Erwin M. R. Volow B. Gray SAE-730122
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973. Sponsored by General Motors Corp.
SAE

*Driver fatigue, *Sleep, *Electroencephalography, *Galvanic skin response measurement, *Biomedical monitoring, *Driving task analysis, *Tracking, *Driving simulators, *Driver performance, *Test volunteers, *Drowsiness,

The phenomenon of drowsiness and sleep during vehicle operation was first studied by noting the normal occurrence of sleep for three male and three female subjects, aged 18-25, in an appropriate environment. The subjects were then tested for drowsiness while performing a simulated driving task. As an individual passes through the stages of wakefulness and sleep, many psychological variables change. The electroencephalographic and skin potential changes as related to wakefulness and sleep are reported.

HS-012 918

DROWSINESS AND DRIVING: PRELIMINARY REPORT OF A POPULATION SURVEY

Duke Univ.
D. H. Tilley C. W. Erwin D. T. Gianturco SAE-730121
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973. Sponsored by General Motors Corp.
SAE

*Driver fatigue, *Driver behavior research, *Driver fatigue caused accidents, *Attention lapses, *Age factor in driving, *Sex factor in driving, *Racial factors, *Driver educational levels, *Driver mileage, *Questionnaires, *Drowsiness,

The hypotheses that drowsiness at the wheel is a behavioral phenomenon experienced by a significant portion of the driving population, and that it is a contributing causal factor in vehicular accidents is tested. A questionnaire on drowsiness and driving, asked of 1500 applicants for license renewal, is included, and frequency distribution of answers by percentage is presented. Responses to several questions are grouped by driver age, sex, race, educational level, and mileage.

HS-012 919

ALCOHOL-INDUCED DEGRADATION OF PERFORMANCE ON SIMULATED DRIVING TASKS

Cornell Aeronautical Lab., Inc.
For primary bibliographic entry see Fld. 3A.
HS-012 924

MEASUREMENT AND INTERPRETATION OF DRIVER STEERING BEHAVIOR AND PERFORMANCE

Systems Technology, Inc.
D. H. Weir D. T. McRuer SAE-730098
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973.
SAE

*Driver performance, *Vehicle control, *Driving task analysis, *Steering, *Driving simulators, *Driving task models, *Mathematical models, *Driver modeling, *Computerized simulation, *Crosswind,

Simulation experiments with random crosswind gust disturbances were used to measure driver-vehicle describing functions for a number of driver subjects and experimental replications. The results are consistent with previous data and show good repeatability within subjects on successive runs. Interpretation of the data in terms of the driver-vehicle model indicates that the driver's outputs can be explained in simplest terms as functions of lateral position and heading. The results demonstrate that driver-vehicle system dynamic response properties can be modeled and measured for a class of important driving tasks. They also provide direct experimental verification of the applicability of driver-vehicle theory for situations where the driver obtains his information from a real world visual simulation.

HS-012 925

A CRITICAL TRACKING TASK AS AN ALCOHOL INTERLOCK SYSTEM

General Motors Corp.
For primary bibliographic entry see Fld. 3A.
HS-012 927

ALCOHOL AND DRUG IMPAIRMENT OF THE DRIVER

California Univ. Inst. of Transp. and Traf. Engineering
For primary bibliographic entry see Fld. 3A.
HS-012 928

ALCOHOL IMPAIRMENT DETECTION BY THE PHYSTEYSTER--EVALUATION PROGRAM SUMMARY

General Motors Corp.
For primary bibliographic entry see Fld. 3A.
HS-012 929

REPRESSIE EN VERKEERSVEILIGHEID (REPRESSION AND ROAD SAFETY)

R. J. Pote
Text in Dutch.
See serial citation

*Traffic law violations, *Penalties, *Police traffic services, *Driver behavior, *Traffic law enforcement, *Traffic ticket systems, *Point systems, *Driver improvement, *Behavior modification,

There is a correlation between the establishment of a traffic offense and accident phenomena. This correlation between the punitive sanction and subsequent behavior of road users has not been proved. The effectiveness of repression depends on its intensity and quality. Traffic supervision could be made more effective by selection and training of competent policemen, by coordination of surveillance services, and by motivation of the mediation policy. Present penalties do not bring about a lasting favorable behavioral change. The infringer's motives are not taken into account and the principles of penology are not respected when inflicting a penalty. In our society, the traffic offense and the penalties that derive from it are not considered dishonorable. A modern ticket system combined with a point system which would, in addition to the sanction, comprise education, treatment, and supervision of offenders, could improve the effectiveness of repression.

HS-012 930

LICENSE LAW ENFORCEMENT. INTERIM REPORT
GTE-Sylvania, Inc.
For primary bibliographic entry see Fld. 3F.
HS-800 840

3F. Driver Licensing

FIELD RESEARCH PLANNING FOR DRIVER'S LICENSE LAW ENFORCEMENT. INTERIM REPORT

GTE-Sylvania, Inc.
J. P. McGuireJ. K. Spaulding M1141
Report for Aug 1971-Feb 1972.
NTIS

*Driver identification, *Driver license laws, *Traffic law enforcement, *Driver license suspension, *Driver license revocation, *Driving without a license, *Driver licenses, *Police, *Traffic law violators, *Program evaluation, *Driver behavior, *Driver mileage, *Driver records, *Accident rates, *Fatality rates, *Driver license restrictions, *Coding systems, *State action, *Traffic courts, *Convictions, *Public opinion, *Questionnaires, *Variance analysis, *Mathematical models, *Penalties,

A controlled field experiment was designed to discourage driving by individuals whose driver's license has been suspended by requiring all drivers to display their driver's license on the vehicle while driving. For this experiment to be effective the expected punishment for driving with a suspended license must be increased and the public must be made aware of this. It was decided to analyze states with 600,000 licensed drivers or less and/or states in which the experiment might be conducted on a county (because the vehicle license plates of that state indicate county). An important consideration was the willingness of a state to support and conduct the experiment. States were checked for driver's license status check and judicial system capability, magnitude of the problem of driving under suspension or revocation, and existence of restricted license programs. Implementation plans are outlined and results of a survey of suspended drivers are analyzed.

HS-800 840

3G. Drugs Other Than Alcohol

ALCOHOL AND DRUG IMPAIRMENT OF THE DRIVER

California Univ. Inst. of Transp. and Traf. Engineering
For primary bibliographic entry see Fld. 3A.
HS-012 928

INSTRUMENTATION DEVELOPMENT FOR DRUG DETECTION ON THE BREATH. FINAL REPORT

Department of Transp., Transp. Systems
J. R. HobbsA. E. Barrington DOT-TSC-NHTSA-72-9
Report for Jul 1971-Apr 1972.
NTIS

*Drugs, *Mass spectrometry, *Chemical analysis, *Spectral analysis, *Urinalysis, *Test equipment, *Measuring instruments, *Ionization,

Mass spectrometry has been identified as a promising technique for drug detection on the breath. To demonstrate its capability

the addition of a membrane separator and a field-ionization source. Fourteen drugs were investigated and it was possible to identify the signatures (mass spectra) of ten of these drugs with the modified instrument. Some drugs were detected by direct sniffing, other first had to be dissolved in a suitable solvent and evaporated. The mass spectra presented in the report indicate the simplicity of field ionization as compared with ionization by the conventional method of electron impact. An example of urinalysis is also presented.
HS-820 253

3L. Vision

FIELD OF VIEW FROM AUTOMOTIVE VEHICLES

Ford Motor Co.
S-72-6
Corporate author

*Field of view, *Eye location, *Peripheral vision, *Central vision, *Rear visibility, *Visual fields, *Visual perception, *Target detection, *Traffic signal visibility, *Sign visibility, *Pedestrian visibility, *Vehicle visibility, *Sign location, *Traffic signal location, *Sight distances, *Overhead signs, *Exterior rearview mirrors, *Interior rearview mirrors, *Night vision, *Head movement, *Eye movements, *Data acquisition, *Data analysis, *Stopping distance, *Field work, *Photogrammetry, *Driver reaction time, *Equations, *Driver vehicle road interfaces,

The field of view required to see overhead and curb mounted signals and signs, standing and moving pedestrians, fixed objects, cyclists, intersecting vehicles, opposing traffic, same direction traffic, overtaking vehicles, and rear approaching cars and trucks, from forward moving vehicles was investigated in a series of research projects that included literature surveys, analytical studies, human factors tests, and photographic road traffic surveys. The research considered forward, side, and rear fields of view. Rear vision through mirror systems was included. Detailed presentations and explanations of the driver's visual fields are given. Background material is provided in the included Technical Notes.

HS-012 940

4. OTHER SAFETY-RELATED AREAS

4B. Community Support

SAMPLING OF DRIVER OPINIONS TOWARD PERIODIC MOTOR VEHICLE INSPECTION

For primary bibliographic entry see Fld. 5I.
HS-012 933

4C. Cost Effectiveness

COMPARISON OF ACCIDENTS AND ILLUMINATION
For primary bibliographic entry see Fld. 2E.
HS-012 935

PROCEDURES FOR ESTIMATING HIGHWAY USER COSTS, AIR POLLUTION, AND NOISE EFFECTS

Stanford Res. Inst.
For primary bibliographic entry see Fld. 2I.

4E. Information Technology

MULTIDISCIPLINARY ACCIDENT INVESTIGATION REPORT AUTOMATION. VOL. 4. UNIVARIATE FREQUENCY DISTRIBUTIONS. FINAL REPORT

Michigan Univ. Hwy. Safety Res. Inst.
For primary bibliographic entry see Fld. 1C.
HS-800 770

4G. Mathematical Sciences

MEASURED STATISTICAL CHARACTERISTICS OF AUTOMOTIVE IGNITION NOISE

General Motors Corp.
For primary bibliographic entry see Fld. 2G.
HS-012 908

A CRITICAL ANALYSIS OF THE ROTARY ENGINE SEALING PROBLEM

TRW, Inc.
For primary bibliographic entry see Fld. 5D.
HS-012 920

MEASUREMENT AND INTERPRETATION OF DRIVER STEERING BEHAVIOR AND PERFORMANCE

Systems Technology, Inc.
For primary bibliographic entry see Fld. 3D.
HS-012 925

RESTRAINT-SYSTEM EFFECTIVENESS

For primary bibliographic entry see Fld. 5N.
HS-012 931

SHOCK INDEX CLASSIFICATION FOR HIGHWAY VEHICLES

For primary bibliographic entry see Fld. 5T.
HS-012 932

THE CATERPILLAR IMEP METER AND ENGINE FRICTION

Caterpillar Tractor Co.
For primary bibliographic entry see Fld. 5D.
HS-012 942

THE EFFECT OF COMBUSTION CHAMBER SHAPE ON NITROGEN OXIDES

Nissan Motor Co. Ltd. (Japan)
For primary bibliographic entry see Fld. 5F.
HS-012 945

A REAR-END BARRIER IMPACT SIMULATION MODEL FOR UNIBODY PASSENGER CARS

General Motors Corp.
For primary bibliographic entry see Fld. 5D.
HS-012 947

VEHICLE CRUSH PREDICTION USING FINITE- ELEMENT TECHNIQUES

Chrysler Corp.
For primary bibliographic entry see Fld. 5D.

NOISE PRODUCED BY UNSTEADY EXHAUST EFFLUX FROM AN INTERNAL COMBUSTION ENGINE

Queen's Univ. of Belfast (Northern Ireland)
For primary bibliographic entry see Fld. 2G.
HS-012 950

A NEW DIESEL COMBUSTION CHAMBER--THE VARIABLE-THROAT CHAMBER

Societe d'Etude des Machines Thermiques
For primary bibliographic entry see Fld. 5D.
HS-012 953

A DIGITAL COMPUTER METHOD FOR THE PREDICTION OF BRAKING PERFORMANCE OF TRUCKS AND TRACTOR-TRAILERS

Michigan Univ. Hwy. Safety Res. Inst.
For primary bibliographic entry see Fld. 5A.
HS-012 956

L-RING EFFECT ON AIR-COOLED TWO-STROKE GASOLINE ENGINES

Musashi Inst. of Tech. (Japan)
For primary bibliographic entry see Fld. 5D.
HS-012 962

FIELD RESEARCH PLANNING FOR DRIVER'S LICENSE LAW ENFORCEMENT. INTERIM REPORT

GTE-Sylvania, Inc.
For primary bibliographic entry see Fld. 3F.
HS-800 840

5. VEHICLE SAFETY

5A. Brake Systems

A DIGITAL COMPUTER METHOD FOR THE PREDICTION OF BRAKING PERFORMANCE OF TRUCKS AND TRACTOR-TRAILERS

Michigan Univ. Hwy. Safety Res. Inst.
J. E. Bernard SAE-730181
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973.
SAE

*Brake performance, *Forecasting, *Truck performance,
*Tractor trailers, *Articulated vehicle performance, *Digital
computers, *Computerized simulation, *Dual axles, *Axle
loads, *Suspension system design, *Vehicle dynamics,
*Stopping distance, *Brake torque, *Tire pavement interface,
*Coefficient of friction, *Tire slip motion, *Antiskid brakes,
*Wheel locking, *Equations of motion, *Brake systems, *Braking
forces,

The digital simulation of the longitudinal performance of trucks
and articulated vehicles was accomplished by analyzing tandem
axle dynamics including four-spring and walking beam suspension
performance; time delays in brake system response and the
relationship between line pressure and brake torque for a brake
system model; and a tire model. A hypothetical antiskid device
was simulated on a tandem axle articulated vehicle. Although

wheel lockup was prevented, the simulated stopping distance increased considerably.

HS-012 956

STOPPING-DISTANCE ANALYSIS

Bendix Corp.

R. L. Lewis R. E. Raymond SAE-730193

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Stopping distance, *Brake performance, *Graphic techniques, *Coefficient of friction, *Tire brake force, *Tire road contact forces, *Braking time, *Performance characteristics, *Tire pavement interface,

A method of plotting and comparing the theoretical, required, and measured stopping distance as required by the Department of Transportation (DOT) is discussed. The high coefficient stopping distance requirements have been extrapolated to American Society for Testing and Materials skid numbers over a range of 50 to 120. This will give the brake system designer more confidence in test results on a known skid number surface. The graphical technique developed, enables the brake system designer to systematically compare predicted and actual performance of various brake system designs on a variety of tire-road coefficients with DOT requirements for the same conditions. Sample graphs are shown along with the instructions for carrying out the procedure.

HS-012 963

5D. Design

HOW TO USE ANAEROBICS SUCCESSFULLY

Loctite Corp.

M. B. Pearce SAE-730135

Presented at International Automotive Engineering Congress, Detroit, 8-12, Jan 1973.

SAE

*Adhesives, *Curing, *Thermosetting resins, *Polyester, *Thermoplastics, *Sealers, *Toxicity, *Gaskets, *Temperature endurance tests, *Strength (mechanics), *Surface treatment, *Leakage tests, *Performance characteristics, *Thermal factors, *Bonding, *Cleaning.

Many design problems associated with threaded fasteners, press-fitted assemblies, and sealing of threaded and flanged assemblies can now be solved by using anaerobic liquid compounds. These one-part polyester resins convert from a liquid to form a tough, thermoset plastic material that completely fills the tolerance gap to augment thread locking, doubles the strength of press-fitted parts, and seals the inner space from environmental attack. These liquid compounds fill all surface irregularities, tolerance gaps, and effectively seal clearances up to 0.020 inches. They can be applied by high-speed applicators on moving production lines while assuring controlled predictable strengths in metal-to-metal assembly applications at substantial cost savings over conventional methods. The cured polyester film provides excellent chemical resistance and resists most liquids and gases within an operating temperature range of -65-300 degrees F (-55-150 degrees C).

HS-012 906

USING ADHESIVES EFFECTIVELY

General Motors Corp.

G. L. Schneberger SAE-730134

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Adhesives, *Adhesion, *Stress (mechanics), *Joints, *Surface treatment, *Cleaning,

An explanation of adhesion and a practical definition of adhesives is presented. The response of common bond designs to shear, tension-compression, cleavage, and peel stresses is then examined. Emphasis is placed on selecting joint designs which will utilize the energy absorbing characteristics of adhesives. The greatest production line problem in adhesive bonding is failure to clean the surface properly. The second greatest problem is failure to keep the surface clean.

HS-012 907

ONE-WIRE AUTOMOTIVE ELECTRICAL SYSTEMS

Ford Motor Co.

J. F. Ziomek SAE-730132

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Electric systems, *Wiring, *Electric system design, *Windshield washers, *Windshield wipers, *Vehicle lighting, *Temperature control, *Automatic control, *Power windows, *Engine operating conditions,

A single-wire vehicle electrical control system is applied to vehicle electrical functions. The resultant three-wire system (signal, power, ground) reduces wire bulk in the floor, door, instrument panel, and engine compartment of the vehicle. Increased control switch and component complexity, due to the additional solid-state components required, may affect overall reliability. Improved power bus and signal bus protection must be added to the control system. Failure of the entire single-wire control system, due to accidental grounds or opens, limits application to certain noncritical vehicle electrical systems.

HS-012 909

PERFORMANCE OF ELECTRONICS IN THE AUTOMOBILE TO DATE AT CHRYSLER

Chrysler Corp.

I. Balan C. J. Van Halteren R. M. Weier SAE-730131

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Electronic devices, *Ignition systems, *Performance characteristics, *Performance tests, *Alternators, *Voltage regulators, *Voltage regulation, *Packaging, *Corrosion prevention, *Service life, *Vehicle maintenance, *Distributors, *Electric cables, *Field tests, *Automobile racing, *Manufacturing inspection, *Quality control, *Stress analysis, *Semiconductors, *Engine diagnostic equipment,

The use of electronics influences the performance, service life, and reliability of automobile components. High-volume usage of electronics is found in automotive charging and ignition systems. The performance of semi-conductor devices in these

August 14, 1973

lications is discussed. The importance of diagnostic equipment is covered, and two specific examples designed for the quick diagnosis of trouble in electronic voltage regulators and electronic ignition systems, respectively, are presented.
HS-012 910

TRANSDUCERS FOR AUTOMOTIVE CONTROL SYSTEMS

General Motors Corp.
L. Zeisler SAE-730130
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
E

Transducers, *Fuel flow, *Air flow, *Control equipment, *Air/fuel ratio, *Exhaust emission control,

A brief review of the function and characteristics of current transducers on the vehicle is presented. As it is the lack of suitable devices which limits many systems, a set of potential transducer needs for certain current and potential systems is outlined. A specific set of transducer requirements for a precision fuel management system is developed.
HS-012 911

ELECTROMAGNETIC INTERFERENCE AND THE AUTOMOBILE

General Motors Corp.
L. Maxam O. T. McCarter D. E. Schofield SAE-730129
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
E

Electromagnetic interference, *Electromagnetic radiation, frequencies, *Electromagnetic radiation measurement, *Electronic systems, *Impedance, *Impedance analyzers, *Voltage, environmental factors, *Electronic devices, *Test equipment, measuring instruments,

An electronic device can receive interference by radiation and induction. Magnetic (inductive), electric (capacitive), and conductive coupling in the automobile and their combined effects are discussed. Methods of electromagnetic interference measurement, the general electromagnetic environment, vehicle operating environment, and internal subsystem interfaces are described.
HS-012 912

AN AUTOMATIC DRIVING SYSTEM OF AUTOMOBILES BY GUIDANCE CABLES

Japan Automobiles Res. Inst., Inc.
H. Furumata F. Harashima H. Inaba S. Matsumoto SAE-730127
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
E

Guidance systems, *Automatic steering control, *Automatic speed control, *Automatic braking, *Control equipment, *Ca-

VEHICLE SAFETY—Field 5 Design—Group 5D

liable structure and could be made at a low cost. The automatic steering system and speed and brake control system are described. Several test runs with a vehicle equipped with the control apparatus were performed. The course deviations were within 20 mm in steady state running for speeds ranging 20-100 km/h. The riders in the vehicle felt fairly comfortable. This system is going to be used for driverless tests of automobiles, and it is also expected to be applied to the dual mode system.
HS-012 914

THE FEASIBILITY OF A CAR CENTRAL COMPUTER

General Motors Corp.
F. P. Caiati F. J. Thompson SAE-730126
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Computers, *Automatic control, *Control equipment, *Feasibility studies, *Electronic devices, *Benefit cost analysis, *Systems analysis, *Flow charts, *Environmental factors, *Vehicle design, *Maintainability, *Systems engineering, *Safety design,

Designing a computer centered control system for a car involves feasibility considerations with emphasis on high volume production of multiple models with stringent safety and reliability requirements. Recent efforts in computer system development on a series of vehicles have allowed evaluation of several system configurations. The characteristics and functional requirements of a car central computer are outlined. The car central computer, though feasible, needs further work to achieve practicality.
HS-012 915

A CRITICAL ANALYSIS OF THE ROTARY ENGINE SEALING PROBLEM

TRW, Inc.
H. F. Prasse H. E. McCormick R. D. Anderson SAE-730118
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Rotary engines, *Power plants, *Apex seals, *Oil seals, *Compression rings, *Engine design, *Mathematical analysis, *Engine size, *Exhaust emission control, *Parts costs, *Engine housings, *Loads (forces), *Engine weight,

The desirable and undesirable characteristics of the rotary engine as an automobile powerplant are compared. In order for the engine to become an inexpensive automobile powerplant, certain seal design parameters should be changed to reduce tolerances required and to eliminate the costly, difficult-to-machine coatings on the trochoid and end-housing running surfaces. An analysis of the loads on the apex seal has been made and design parameters set up for a material to eliminate, or greatly reduce, the chatter problem. The geometry of the side

AN EVALUATION OF THE POTENTIAL PERFORMANCE GAIN FROM LEAKAGE REDUCTION IN ROTARY ENGINES

General Motors Corp.
M. K. Eberle E. D. Klomp SAE-730117
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973.
SAE

*Rotary engines, *Leakage, *Engine performance, *Seals,
*Simulation models, *Pressure responses, *Compression, *En-
gine speeds, *Loading (mechanical), *Engine operating condi-
tions, *Engine tests, *Leakage tests, *Fuel consumption,
*Thermal efficiency,

A rotary engine analytical model which permits calculation of apex- and side-seal leakage was used in conjunction with experimental results to estimate the relative importance of such leakage. Comparing side-seal leakage to total leakage suggests that the side-seal leakage represents about one fourth to one third of the total. At wide open throttle there is an improvement in indicated mean effective pressure, which is a function of the product of volumetric efficiency and indicated thermal efficiency, ranging from about 10% at 7000 rpm to 30% at 200 rpm if leakage area can be reduced to one-half the present value. Under road load operating conditions, a leakage-area reduction of 50% will reduce indicated specific fuel consumption at 2000 rpm by about 6-1/2%, and at 4000 rpm by about 4-1/2%.
HS-012 921

CALCIUM DEOXIDIZED IMPROVED MACHINING STEELS FOR AUTOMOTIVE GEARS

Republic Steel Corp.
V. A. Tipnis R. A. Joseph J. H. Doubrava SAE-730115
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973.
SAE

*Metal cutting, *Gears, *Steels, *Calcium, *Aluminosilicates,
*Machining, *Carburizing, *Annealing, *Mechanical properties,
*Abrasion, *Wear tests, *Service life,

A new family of improved machining gear steels has been developed using calcium deoxidation. Using these steels, the rougher and finisher cutter tool life during gear cutting on automotive differential drive pinions and ring gears has been improved by as much as 70-100%. These calcium deoxidized steels are fine grained and exhibit identical hardenability, carburizing, and heat treat response as that of the conventional Al-Si deoxidized steels. The mechanical properties such as impact strength, tensile strength, ductility, and fatigue resistance of the calcium deoxidized steels are essentially the same as those of the conventional Al-Si deoxidized steels. The application of calcium deoxidized steels for carburizing as well as through-hardening grades for transmission gears, steering worms, as well as pinion and ring gears used in trucks, tractors, and off-the-road equipment also shows promise of substantial gains in tool life with resultant cost savings and productivity gains.
HS-012 922

GLASS-CERAMIC HEXAGONAL AND CIRCULAR PASSAGE SURFACES-HEAT TRANSFER AND FLOW FRICTION (design characteristics)

Stanford Univ.
A. L. London R. K. Shah SAE-730100
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973.
SAE

*Heat transfer, *Flow, *Surface friction, *Glass, *Ceramics,
*Regenerator design, *Gas turbine engines, *Tubes, *Shape,
*Circles, *Hexagons, *Pores, *Geometry, *Materials tests,

Heat transfer and flow friction design characteristics are presented for some second-generation glass-ceramic heat exchanger surfaces. These surfaces are of interest in their application as the matrix for the rotary regenerator of the vehicular gas turbine engine. The paper gives the results for four test matrices for which area densities are given. Two matrices had hexagonal cross-sectional passages and two had circular passages. Test results, derived by the single-blow transient technique, are compared with predictions from laminar flow conduction theory. These surfaces have some advantages over the currently employed triangular passage geometry. The significance of these advantages in terms of the regenerator thermal performance and envelope geometry is discussed.
HS-012 923

SOLID-STATE BREATH ALCOHOL VEHICLE INTERLOCK SYSTEM

Environmental Metrology Corp.
For primary bibliographic entry see Fld. 3A.
HS-012 926

TOWARD HIGHER SPEEDS AND OUTPUTS FROM THE SMALL DIESEL ENGINE

Ricardo and Co. Engineers Ltd. (England)
D. Broome SAE-730149
Presented at International Automotive Engineering Congress,
Detroit, 8-12 Jan 1973. Sponsored by Army Tank Automotive Command.
SAE

*Diesel engines, *Engine size, *Engine speeds, *Engine design,
*Engine performance, *Power output, *Combustion, *Turbocharging, *Engine tests, *Crankcases, *Crankshafts, *Connecting rods, *Pistons, *Cylinders, *Cylinder heads, *Fuel injection, *Cooling system design, *Coolants, *Lubrication systems, *Friction, *Air injection, *Ignition delay, *Combustion chambers, *Loading (mechanical), *Cylinder pressure, *Single cylinder engines, *Engine operating conditions,

Combustion, breathing, and friction problems in diesel engines at very high speeds, found only in gasoline racing engines, and under boosted conditions were studied. A single-cylinder test engine was evolved to allow detailed investigations of these problems to be undertaken, and its design and components are described. Tests results show that the required rating can be achieved, and that a viable mechanical design to meet the severe operating conditions is possible. Included are preliminary studies of package size and performance of a possible four cylinder version of the engine for military use.
HS-012 941

THE CATERPILLAR IMEP METER AND ENGINE FRICTION

Caterpillar Tractor Co.
W. L. Brown SAE-730150

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Cylinder pressure, *Pressure transducers, *Metering, *Diesel engines, *Friction, *Mathematical analysis, *Volume, *Generators, *Cams, *Voltage, *Calibration, *Errors, *Analog computers, *Thermodynamics, *Combustion, *Heat transfer, *Performance tests, *Fuel pumps, *Engine operating conditions, *Temperature,

Measurements of six diesel engines, both prechamber and direct injection, indicate that the indicated mean effective pressure (imep) meter exceeds design goals on accuracy of plus/minus per atmosphere of pressure in the inlet manifold; the meter can withstand engine operation caused shock and vibration and still perform satisfactorily; circuits are stable and do not require frequent adjustment; imep meter installation does not require special engine modifications; mechanical friction is a function of engine speed, oil and/or jacket water temperature, and engine design and is independent of load, manifold pressure, inlet air temperature, and altitude; pumping losses are dependent on engine speed, inlet air density, manifold pressures, and valve size and port design, and only slightly dependent on the air fuel ratio; heat losses during motoring are large and, together with pumping losses, make up the difference between motoring friction and the true mechanical frictions; heat losses when the engine is firing are an important factor in engine efficiency.

HS-012 942

EFFECTS OF SPARK LOCATION AND COMBUSTION DURATION ON NITRIC OXIDE AND HYDROCARBON EMISSIONS

General Motors Corp.

For primary bibliographic entry see Fld. 5F.
HS-012 944

TEST PLANNING AND EXECUTION FOR GENERAL MOTORS EXPERIMENTAL SAFETY VEHICLE PROGRAM

General Motors Corp.

W. F. Kruckeberg D. S. Shaw R. C. Moore D. L. Crockett SAE-730155

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Experimental automobiles, *Safety cars, *Automobile tests, *Compliance tests, *Performance tests, *Automobile performance, *Crashworthiness, *Impact sleds, *Specifications, *Barrier collision tests, *Nondestructive tests, *Test equipment, *Test facilities, *Data acquisition, *High speed photography, *Automobile handling, *Crash tests, *Anthropomorphic dummies, *Brake tests, *Field of view, *Durability tests, *Windshield wipers, *Emission tests,

During the General Motors Experimental Safety Vehicle (ESV) program, a test plan was prepared for submission to the U.S. Department of Transportation. The plan presented a comprehensive test program, including methodology, procedures, data acquisition, instrumentation and facility requirements, and recommended test sequences providing for evaluation of vehicle performance in areas of crash injury reduction and accident avoidance, consistent with the number of test vehicles availa-

ble. A comprehensive in-house test program, similar to the Government test plan, was prepared and utilized during the prototype development phases of the General Motors ESV project to validate contract performance specifications. The in-house test program is described.

HS-012 946

A REAR-END BARRIER IMPACT SIMULATION MODEL FOR UNIBODY PASSENGER CARS

General Motors Corp.

K. Lin SAE-730156

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Simulation models, *Unitized body construction, *Rear end impact tests, *Barrier collision tests, *Computerized simulation, *Equations of motion, *Computer programs, *Structural deformation analysis, *Crashworthiness, *Loading (mechanical), *Vehicle dynamics, *Crushing, *Degrees of freedom, *Impact velocity, *Friction, *Acceleration, *Mathematical models,

A five degree of freedom system consisting of a rigid barrier mass, four vehicle masses, and seven nonlinear resistances represents the vehicle impacting the barrier, or vice versa. Five equations of motion are derived and ten initial conditions are specified for the model to define an initial-value problem. Due to the complexities of force-deformation characteristics of the resistances, the solution is derived by a numerical method. A computer program in PL/I for the IBM 360/65 is developed to perform the solution. The simulation results are in good agreement with the results of the actual barrier test. Examples of application are included.

HS-012 947

VEHICLE CRUSH PREDICTION USING FINITE-ELEMENT TECHNIQUES

Chrysler Corp.

J. E. Thompson SAE-730157

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Crushing, *Forecasting, *Automobile modeling, *Structural deformation analysis, *Computer programs, *Pendulum tests, *Side impact tests, *Barrier collision tests, *Vehicle vehicle collisions, *Degrees of freedom, *Strain (mechanics), *Stiffness, *Equations of equilibrium, *Stress (mechanics), *Matrix reduction, *Computerized simulation,

Predictive or control capability is embodied in two large computer programs. TELSAP forms, reduces, and inverts the vehicle structure mass matrix expressed relative to a datum coordinate system and writes the mass matrix and its inversion onto a file for reading by the CRUSH program. CRUSH is a general matrix structural analysis program which calculates the large, plastic, rate-sensitive response of an interconnected beam structure due to known dynamic boundary displacement inputs. Experimental correlation with the computer models is given for a vehicle-to-vehicle 90 degree intersection collision between a special rigid moving barrier and an intermediate size four-door sedan. The structural model was further correlated with a laboratory test of a clamped-clamped beam struck at its center by an impact pendulum. The correlation indicates general agreement between experimental and analytical results.

VEHICLE ATTITUDE EFFECTS ON EXTERIOR PROTECTION, HEADLAMP AIMING, DRIVER VISION CAPABILITIES

American Motors Corp.

J. B. McIntyre T. L. Logar SAE-730165

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Vehicle attitudes, *Design standards, *Bumper standards, *Headlamp standards, *Headlamp aiming, *Static loads, *Dynamic loads, *Weight transfer, *Compliance tests, *Field of view, *Suspension systems, *Vehicle dynamics, *Loading (mechanical),

The accurate prediction of vehicle attitudes under both static and dynamic loading conditions is necessary in order to ascertain the actual performance of the vehicle in regard to federal standards. The variations in attitude due to static tolerance build-up, static loading variations, and dynamic attitude changes are discussed with regard to headlamp aiming, bumper effectiveness, and driver vision.

HS-012 951

VEHICLE ATTITUDE CONTROL METHODS

Monroe Auto Equipment Co.

R. Hegel SAE-730166

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Vehicle attitudes, *Automatic level control, *Suspension systems, *Vehicle riding qualities, *Suspension system spring rates, *Shock absorbers, *Loading (mechanical), *Vehicle height, *Hydraulic equipment, *Adjustable springs, *Compressed air, *Air pumps, *Load modulation valves,

Vehicle suspension systems must provide reasonable ride comfort and handling and be versatile enough to permit large changes in vehicle loading. Current constraints on vehicle attitude variation allow a reasonable compromise between ride and this variation, using an open loop relationship between loading and attitude. The load reaction change at the front is much less than the rear. The best choice, from a cost and reliability standpoint, would be a rear auxiliary suspension system because it is the most cost beneficial and because a total failure of the leveling system would not render the car unusable. The fundamentals of suspension related to vehicle attitude and several closed loop attitude control systems, including air-hydraulic suspensions, hydraulic auxiliary and auxiliary hydraulic (self-contained) systems, air spring shock absorbers, and auxiliary air springs, are described.

HS-012 952

A NEW DIESEL COMBUSTION CHAMBER--THE VARIABLE-THROAT CHAMBER

Societe d'Etude des Machines Thermiques

B. Brisson A. Ecomard P. Eyzat SAE-730167

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Variable throat combustion chambers, *Diesel engines, *Engine performance, *Combustion chamber design, *Railroad engines, *Combustion rate, *Heat transfer, *Cyclic pressures, *Air fuel ratio, *Engine tests, *Durability tests, *Precombustion chamber engines, *Diesel engine exhaust emissions, *Fuel injection, *Injection timing, *Fuel consumption,

Compared to a standard precombustion chamber, the variable-throat combustion chamber gains in both overall efficiency and maximum pressure. Compared to a direct-injection engine, a 30% decrease in maximum pressure with the same efficiency is evident. Design details are discussed, along with combustion speed, heat transfer coefficient, and reliability testing. The variable-throat chamber emits fewer pollutants than conventional combustion chambers. The chamber is intended primarily for railroad locomotives, and its adaptation on railroad engines is outlined.

HS-012 953

FUEL QUALITY OR ENGINE DESIGN: WHICH CONTROLS DIESEL EMISSIONS?

American Oil Co.

For primary bibliographic entry see Fld. 5F.

HS-012 954

THE BRAUN LINEAR ENGINE

Tectonics Res. Inc.

A. T. Braun P. H. Schweitzer SAE-730185

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Linear systems, *Engine design, *Engine performance, *Kinematics, *Compressors, *Fuel economy, *Fuel consumption, *Engine tests, *Engine balancing, *Free piston engines, *Velocity, *Engine comparisons, *Braun linear engines,

The Braun linear engine is eminently suited to drive reciprocating compressors, pumps, and other machinery which accept linear power input. The unconventional starting is an important asset of the Braun machine. Ordinarily, in a conventional engine compressor only the air delivery stops when the tank becomes full, the engine continues to idle. In this machine, the engine stops and restarts perhaps in a few seconds when the tank pressure calls for the resumption of air delivery. An engine compressor of this design weighs less than one-third of the conventional machine and has only two major moving parts. It is more durable, reliable, uses less fuel, and is completely balanced.

HS-012 959

SQUISH VELOCITY IN THE COMBUSTION CHAMBER OF A 2-STROKE CYCLE ENGINE

McCulloch Corp.

A. Ziv SAE-730186

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Two stroke cycle engines, *Combustion, *Engine performance, *Combustion rate, *Engine tests, *Cylinder pressure, *Turbulence, *Air fuel ratio, *Ignition timing, *Engine speeds, *Combustion chambers, *Power output, *Cylinder heads, *Fuel consumption, *Crankshafts, *Spark timing, *Misfiring, *Ionization, *Squish velocity,

The effect of squish velocity on two stroke engine performance is discussed. Four combustion chambers, with different squish velocities, were studied. Squish velocity was changed by varying the combustion chamber to the piston area ratio, leaving all other parameters constant. The study concluded that squish velocity has a major effect on optimum ignition timing and rate of combustion pressure rise, with a lesser effect on power, ignition voltage, and spark duration.
HS-012 960

THROTTLING OF 2-STROKE CYCLE DIESEL ENGINES AT PART-LOAD AND IDLING

Institute of Vocational Training (Japan)
E. Watanabe, Fukutani K. Komotori K. Miyake SAE-730187
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Diesel engines, *Throttling, *Idling, *Loading (mechanical), *Scavenging, *Engine tests, *Fuel injection, *Blowers, *Engine speeds, *Cylinder pressure, *Temperature, *Smoke, *Exhaust densities, *Bus tests, *Fuel consumption, *Crankcases, *Test equipment, *Recirculation, *Two stroke cycle engines,

In order to improve the part-load and idling characteristics of two-stroke cycle diesel engines, the effect of throttling on engine performance was investigated on a separately scavenged engine with a Roots blower and on a crankcase-scavenged engine. For the first engine, decreasing the delivery ratio through bypassing a part of scavenging air into the inlet side, that is, by recirculation of scavenging air, made it possible not only to decrease the fuel consumption but also to raise the scavenging temperature which improved combustion. A vehicle test using a bus powered by the same type of engine showed improved mileage through throttling. For the crankcase-scavenged engine, a slight increase in delivery ratio was very effective for improving the performance at low speed with heavy load, and throttling was also effective in improving not only the part-load but also the idling operation.
HS-012 961

L-RING EFFECT ON AIR-COOLED TWO-STROKE GASOLINE ENGINES

Musashi Inst. of Tech. (Japan)
S. Furuhashi H. Ichikawa SAE-730188
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Piston ring design, *Air cooled engines, *Two stroke cycle engines, *Engine performance, *Temperature, *Seals, *Loading (mechanical), *Cylinders, *Pressure, *Blowby, *Engine speeds, *Pistons, *Mathematical analysis,

Experiments on the sealing and cooling effect of the L-ring (a piston ring with an L-shaped cross section) were conducted comparing it with a rectangular ring. Results indicate that the piston reaches so high a temperature that the rubbing surfaces of the piston and the lubricating oil are deteriorated. Then the frictional resistance increases and the piston sometimes falls into the seizure. The L-ring has more cooling effect, so it can increase engine power safely. The L-ring effect does not depend on its cross-sectional shape, but upon its position in the piston because it can be positioned at the upper edge of the piston shoulder. The cooling effect of the piston with upper positioned

rings is caused by not only shortening the path of the heat flow from the head to the ring, but also by decreasing the heating area from the top land.
HS-012 962

AUTOMOTIVE TAPE RECORDER. VOL. 2. DEVELOPMENT TEST REPORT. FINAL REPORT

AVCO Corp.
AVSD-0135-72-CR
Report for Feb-Nov 1972.
NTIS

*Tape recorders, *Performance tests, *Vibration tests, *Road tests, *Electromagnetic interference, *Low temperature, *High temperature, *Humidity, *Temperature endurance tests, *Accelerometers, *Sensors, *Pressure transducers, *Speed sensors, *Potentiometers, *Magnetic tapes, *Shock (mechanics), *Performances characteristics, *Test equipment, *Test facilities,

The development tests on the Automotive Tape Recorder are discussed. Five tape recorder assemblies with transducers were subjected to shock, vibration, humidity, high and low temperatures, electromagnetic interference, and rough road tests. A matrix of the test series and the sequence of the tests are included. Each test is described and the results of each test are discussed individually. The test hardware is illustrated throughout the report. The Automotive Tape Recorder Assembly, using magnetic tape deck P/N 325025, meets all the performance specifications over the tested environmental conditions and is recommended for use.
HS-800 806

BASIC RESEARCH IN CRASHWORTHINESS 2--SIDE IMPACT TEST OF UNMODIFIED VEHICLES. INTERIM TECHNICAL REPORT

Calspan Corp.
J. E. Greene YB-2987-V-9
NTIS

*Crashworthy bodies, *Crashworthiness, *Side impact tests, *Pole impact tests, *Impact velocity, *Passenger compartments, *Vehicle size, *Compact automobiles, *Unitized body construction, *Frames, *Impact angle, *Anthropometric dummies, *Instrumentation, *Accelerometers, *Photographs, *Data processing, *Damage severity, *Lateral intrusion, *Vehicle kinematics, *Occupant kinematics, *Structural deformation analysis, *Acceleration response, *Automobile design, *Loads (forces), *Occupant protection,

Seven vehicle side impact tests and a single vehicle lateral pole impact were performed with unmodified automobiles to establish the crashworthiness of American automobiles under impacts encompassing perpendicular side collisions between full-size, frame chassis automobiles through a 15 mph to 45 mph speed range, perpendicular side collisions of compact and subcompact automobiles struck by full-size automobiles at 30 mph, a perpendicular side collision of a full-size, unibody automobile at 30 mph, an oblique side collision between full-size, frame chassis automobiles at 45 mph, and a lateral impact of a full-size, frame chassis automobile against a pole at 21 mph. Test results indicate the nominal upper level of occupant protection provided by the full-size conventional automobiles and the degraded side collision crashworthiness associated with

Group 5D—Design

smaller vehicles. Areas of structural and passenger compartment interior design are defined where modifications or refinements are needed to enhance occupant protection in side impact collisions.

HS-800 818

REAR END STRUCTURAL CRASHWORTHINESS OF UNITIZED CONSTRUCTION VEHICLES. FINAL SUMMARY REPORT

Dynamic Science

R. L. Anderson. E. Enserink 2310-73-26

Report for July 1970-Jan 1973. For abstract and search terms, see HS-800 734 (HSL-73-7) and HS-800 816 (HSL-73-14).

NTIS

HS-800 830

AMBULANCE DESIGN CRITERIA. REV. ED.

National Hwy. Traf. Safety Administration

Prepared in cooperation with the Committee on Ambulance Design Criteria and the National Res. Council. efficiency, standardization of optional equipment,
GPO \$0.50

*Ambulance design, *Design standards, *Vehicle safety standards, *Federal control, *Emergency equipment, *Vehicle performance, *Vehicle characteristics, *Electric system design, *Vehicle lighting, *Body design, *Passenger compartments, *Seat design, *Windows, *Rearview mirrors, *Controlled air environment systems, *Communication systems, *Spare tires, *Tools, *Sun visors,

Performance and design criteria for an ambulance vehicle are determined and documented in sufficient detail so that automotive designers can produce a vehicle suitable not only to present day practices, but also with adequate provision for future advances in equipment and administration of emergency care. Design criteria of special significance include patient compartment design for privacy and medical efficiency, standardization of optional equipment, environmental control, communications, external identification, rapid acceleration capability, and adherence to design standards applicable to the type of chassis employed. Design requirements for all ambulance systems are presented and applicable Federal Motor Vehicle Safety Standards are described.

HS-820 264

5F. Fuel Systems

TRANSDUCERS FOR AUTOMOTIVE CONTROL SYSTEMS

Ford Motor Co.

For primary bibliographic entry see Fld. 5D.

HS-012 911

DIGITALLY PROGRAMMED ENGINE FUELLING CONTROLS

Lucas (tjoseph) (teletrical) Co. Ltd. (England)

J. P. Soltak. B. Senior. B. Rowe SAE-730128

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

*Electronic fuel injection, *Fuel systems, *Exhaust emission control, *Injection timing, *Engine speeds, *Digital computers, *Air fuel ratio, *Air flow, *Otto cycle engines, *Intake manifold pressures, *Exhaust emission measurement, *Ignition timing, *Torque,

For a particular engine and at a given engine speed, the throttle angle will indicate directly the air being aspirated per unit time. Thus a control following a surface whose height indicates the fuel requirement based on both throttle angle position and engine speed will give a unique fueling value under all conditions. A fuel control system which employs this technique is described and a digital computing method used to transpose the value of throttle angle and speed into a fuel quantity injected in the engine intake tract every cycle is explained. Factors determining the type of electric to hydraulic interface required are discussed. Although unaided fuel injection cannot meet the Federal 1975 and 1976 exhaust pollution requirements it can make a contribution to the problem by enabling the engineer to supply his afterburning device with a gas stream of closely controlled quality.

HS-012 913

THE EFFECT OF CHARGE DILUTION ON CBC VARIATIONS AND EXHAUST EMISSIONS OF AN SI ENGINE

Chrysler Corp.

W. J. Anderson. S. S. Lestz. W. E. Meyer SAE-730152

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973. Sponsored by Texaco Inc.

SAE

*Exhaust emission control, *Charge dilution, *Exhaust emission measurement, *Exhaust emission sampling, *Engine performance, *Spark ignition engines, *Nitrogen oxides, *Hydrocarbons, *Cyclic pressures, *Combustion, *Computerized test methods, *Engine operating conditions, *Power output, *Compression ratio, *Carbon dioxide, *Nitrogen, *Air fuel ratio,

Current methods for reducing emission of nitrogen oxides from the spark ignition engine employ dilution of intake charge with relatively inert gases which tends to limit peak combustion temperatures and pressures. Employment of intake charge dilution has led to reduction in engine power output and increased combustion cycle-by-cycle (CBC) irregularity. This investigation sought to determine the degree of increased CBC combustion variations experienced as increased amounts of charge dilution reduced emission of nitrogen oxides. Emission of unburned hydrocarbons was also documented. It was found that increased CBC variations result from employing intake charge dilution as a tool to reduce nitrogen oxides emissions. The significant aspects of the increased CBC variations were an observed increase in maximum cyclic pressure dispersion, a slower flame speed as reflected by an increased angle of occurrence of peak cyclic pressure, and increased variations in the crank angle of peak pressure.

HS-012 943

EFFECTS OF SPARK LOCATION AND COMBUSTION DURATION ON NITRIC OXIDE AND HYDROCARBON EMISSIONS

General Motors Corp.

August 14, 1973

VEHICLE SAFETY—Field 5

Fuel Systems—Group 5F

Presented at International Automotive Engineering Congress, Detroit, 812 Jan 1973.
SAE

*Exhaust emission control, *Spark plugs, *Engine modification, *Exhaust emission measurement, *Nitric oxide, *Hydrocarbons, *Combustion chamber design, *Spark ignition engines, *Charge dilution, *Test equipment, *Exhaust emission tests, *Engine operating conditions, *Air fuel ratio, *Single cylinder engines,

This study describes the effect of spark plug location on nitric oxide (NO) and hydrocarbons (HC) emissions from a single-cylinder engine with a specially modified combustion chamber. The effects of changes in combustion duration caused either by spark location, dual spark plugs, or charge dilution on NO and HC emissions were also examined. Nitric oxide emissions were the same with the spark plug located either near the intake or exhaust valve, but were higher with the spark plug midway between the valves or with dual ignition. Hydrocarbon emissions were lowest with the spark plug nearest the exhaust valve and increased with the distance of the spark plug from the exhaust valve. With charge dilution the decrease in NO emission was isolated into a pure dilution effect and a combustion duration effect. The combustion duration effect was minimal at rich mixtures and increased with air fuel ratio. The implications of these results are presented and discussed.

HS-012 944

THE EFFECT OF COMBUSTION CHAMBER SHAPE ON NITROGEN OXIDES

Nissan Motor Co. Ltd. (Japan)

Y. SakaiH. MiyazakiK. Mukai SAE-730154

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Combustion chamber wall angles, *Nitrogen oxides, *Exhaust emission measurement, *Combustion chamber design, *Spark plugs, *Combustion, *Lean fuel mixtures, *Exhaust gas recirculation, *Air fuel ratio, *Mathematical analysis, *Exhaust emission tests, *Temperature, *Pressure, *Single cylinder engines,

The effect of combustion pattern was investigated by changing combustion chamber shape and spark plug location, using a single cylinder, 4-cycle gasoline engine with designed homogeneous premixed gas. Nitric oxide concentration with the normal spark plug location shows an upward trend with more compact combustion chamber shapes. When the spark plug location is shifted, the initial heat release becomes moderate, the peak combustion temperature is lowered, and nitric oxide decreases greatly. The tolerance for lean mixture operation and for exhaust recirculation is narrowed, and the cycle-to-cycle variation of combustion pressure increases. Engine output, however, is not strongly affected by changes in combustion chamber shape and spark plug location. In an actual multicylinder engine, such

EXHAUST EMISSION CHARACTERISTICS OF A SMALL 2-STROKE CYCLE SPARK IGNITION ENGINE

Pennsylvania State Univ.

R. E. KollmanS. S. LestzW. E. Meyer SAE-730159

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973. Sponsored by Rockwell Mfg. Co.
SAE

*Two stroke cycle engines, *Exhaust composition, *Exhaust emission tests, *Exhaust emission measurement, *Gas analysis, *Unburned hydrocarbons, *Air fuel ratio, *Scavenging, *Nitrogen oxides, *Carbon monoxide, *Models, *Chemical reactions, *Isocetane, *Loads (forces), *Engine speeds, *Ambient temperature effect on exhaust, *Engine operating conditions, *Spark ignition engines,

The results of a two stroke engine study conducted to determine the level of the unburned hydrocarbon (HC) emission and its source and other gas phase exhaust emissions are reported. Exhaust composition curves were generated from a material balance model with HCs included as a product. The calculated curves were used in the data analysis. It was determined that 25-40% of the fuel air mixture was short-circuited to the exhaust in the scavenging process which resulted in unburned HC concentrations of 5000-1000 ppm hexane equivalent. It was found that short-circuiting is a function of load but is relatively independent of speed. Emission of carbon monoxide is highly dependent on carburetor tuning and can be reduced to less than 1% volume by tuning alone. Nitrogen oxides emissions are very low and are a function of mixture strength and ambient conditions.

HS-012 949

NOISE PRODUCED BY UNSTEADY EXHAUST EFFLUX FROM AN INTERNAL COMBUSTION ENGINE

Queen's Univ. of Belfast (Northern Ireland)

For primary bibliographic entry see Fld. 2G.

HS-012 950

FUEL QUALITY OR ENGINE DESIGN: WHICH CONTROLS DIESEL EMISSIONS?

American Oil Co.

E. ShamaH.T. O. Wagner SAE-730168

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Diesel engine exhaust emissions, *Fuel quality, *Engine design, *Exhaust emission control, *Smoke, *Engine tests, *Exhaust emission tests, *Smoke meters, *Exhaust emission measurement, *Hydrocarbons, *Nitrogen oxides, *Carbon monoxide, *Steady state, *Idling, *Exhaust emission standards,

The effects of fuel properties on emissions are much smaller than those of engine design and operating conditions. In most diesel engines, changing from a high density to a low density fuel will reduce smoke and emissions of carbon monoxide at wide open throttle. But at other throttle positions, the

Group 5F—Fuel Systems

fuels are relatively small. Tests of four-stroke engines indicate that changing fuel—even by drastic changes in boiling range and hydrocarbon composition—has little effect on hydrocarbon emissions. Lighter fuels, which were more volatile, caused higher hydrocarbons in tests of a two-cycle engine. Changing fuel had no significant effect on nitric oxide in any of the engines used.

HS-012 954

SURVEYING TESTS OF DIESEL SMOKE SUPPRESSION WITH FUEL ADDITIVES

Waseda Univ. (Japan)

T. Saito M. Nabetani SAE-730170

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Smoke control, *Diesel engine exhaust emissions, *Exhaust emission tests, *Fuel additives, *Engine tests, *Exhaust gas recirculation, *Barium, *Bus tests, *Engine deposits, *Japan, *Engine operating conditions, *Engine performance, *Toxicity, *Exhaust composition, *Road tests, *Laboratory tests, *Fuel consumption,

The diesel smoke reduction effect of 26 fuel additives marketed in Japan was tested with bench tests on several types of engines under the conditions of overload with heavy smoke. The four effective barium-containing additives were tested under further conditions which included improper engine maintenance, transient operation, and exhaust gas recirculation. The exhaust gas compositions and emitted barium solids were analyzed. Also road tests were performed with 12 city buses for two years. Barium additives affect engine deposits and thus toxicity and are very effective in depressing diesel smoke. They have no great influence on exhaust composition and engine performance.

HS-012 955

5I. Inspections

SAMPLING OF DRIVER OPINIONS TOWARD PERIODIC MOTOR VEHICLE INSPECTION

H. W. Sherman

Sponsored by Hwy. Res. Board Com. on Vehicle Inspection and Regulation.

See serial citation

*Vehicle inspection, *Opinion polls, *Public opinion, *Driver attitudes, *Ann Arbor, *Cincinnati, *District of Columbia, *Socioeconomic data, *Questionnaires, *Driver characteristics,

A sampling of the opinions of motor vehicle operators was obtained to determine public attitudes toward several aspects of motor vehicle inspection. The survey was conducted in Ann Arbor, Michigan, Cincinnati, Ohio, and Washington, D.C. while the operators were having their vehicles inspected at lane type facilities. The inspection standards were similar in each of the cities; however, the periods of inspection varied. The results of this survey indicate that those who responded were overwhelmingly in favor of motor vehicle inspection. Areas of opposition appeared to be very minor.

HS-012 933

5N. Occupant Protection

RESTRAINT-SYSTEM EFFECTIVENESS

E. S. Grush S. E. Henson O. R. Ritterling

Includes discussion by C. Y. Warner and author's closure. Sponsored by Hwy. Res. Board Com. on Vehicle Characteristics.

See serial citation

*Restraint system effectiveness, *Restraint system tests, *Air bag restraint systems, *Shoulder harnesses, *Seat belts, *Three point restraint systems, *Accident survivability, *Accident studies, *Computerized simulations, *Mathematical models, *Accident simulation, *Human deceleration tolerances, *Accident severity, *Impact velocity, *Impact angle, *Human body precrash position, *Accident records, *Accident types, *Restraint system usage, *Animal experiments,

The potential number of lives that could be saved each year through the universal installation and use of seat belts, shoulder harness systems, and air bag restraint systems was calculated and the estimates for each restraint system were compared. Two tasks were undertaken to obtain the lives saved estimates. One task involved mathematical modeling of each occupant restraint and vehicle system in order to establish potential head and chest decelerations in each of a number of crash situations. Human tolerance formulations were then used to convert these decelerations into values reflecting the ability of the restraint to save lives in each given crash situation. The second task in the study was an examination of traffic accident records to determine the relative frequency of fatalities occurring in each crash situation. Results indicate that the shoulder harness system could potentially save more lives than the simulated air bag system. The harness system is valuable, however, only if used.

HS-012 931

DEVELOPMENT OF AN INFLATABLE RESTRAINT SYSTEM FOR REAR SEAT OCCUPANTS. FINAL REPORT

Calspan Corp.

D. J. Romeo R. A. Rose ZM-5028-K-2

Report for Oct 1972-Jan 1973.

NTIS

*Air bag restraint systems, *Rear seat passengers, *Restraint system tests, *Barrier collision tests, *Air bag inflation pressure, *Air bag inflation time, *Honeycomb structures, *Knee restraints, *Head restraints, *Anthropometric dummies, *Test equipment, *Test facilities, *Data acquisition, *Data reduction, *Occupant kinematics, *Impact velocity, *Acceleration response, *Loads (forces), *Femurs, *Impact angle, *Deflection, *Photographs,

An inflatable occupant restraint system for unbelted rear seat occupants of full size vehicles was tested. A crushable honeycomb knee bar was developed to limit femur loads and control head and upper torso trajectories of unbelted occupants. For impact speeds above 20 mph an air bag deploys; the bag loads are carried out through the knee bar support plate and through the head bar. A previously developed system was optimized for adult passenger protection in high speed crashes. The restraint was effective in controlling dummy loads for an impact velocity of 51 mph. Because rapidly deploying restraint

systems are dangerous to small children positioned against the restraint prior to deployment, crash tests of the system were performed using reduced inflation gas. This system controlled dummy loads for 30 mph frontal and 30 degrees oblique barrier crashes. Acceptable adult-sized dummy protection at velocities much above 30 mph with this system is doubtful.

HS-800 836

EFFECTIVENESS OF SAFETY BELT WARNING AND INTERLOCK SYSTEMS. FINAL REPORT

National Analysts, Inc.

J. B. Cohen A. S. Brown

Report for Jul 1972-Apr 1973.

NTIS

*Restraint system usage, *Seat belt fastening warning systems, *Ignition restraint system interlocks, *Driver attitudes, *Three point restraint systems, *Inertia reels, *Fayetteville (N. C.), *Restraint system assemblies, *Counters, *Interviews, *Warning system effectiveness, *Shoulder harnesses, *Questionnaires, *Warning system deactivation,

Rental cars in Fayetteville, N. C., were equipped with four seat belt and warning systems: (Phase 1) detachable shoulder and lap belt, no warning system; (Phase 2) detachable shoulder and lap belt, warning system; (Phase 3) non-detachable shoulder and lap belt with inertia reel on shoulder belt, warning and logic system; and (Phase 4) non-detachable shoulder and lap belt with inertia reel on shoulder belt, warning, logic, and starter/interlock system. Counters were installed in the cars to measure restraint system usage. Interviews were conducted with the drivers to determine attitudes toward the four systems. A significant increase in measured use of seat belts was seen from Phase 1 to Phase 2, 3, and 4, however there was no significant difference in the measured usage rates in the last three phases. Drivers in Phases 1 and 2 voiced more favorable attitudes toward the seat belt and warning systems than did respondents in Phases 3 and 4.

HS-800 859

DATA RELEVANT TO THE PERFORMANCE OF HEAD RESTRAINTS IN COLLISIONS

National Hwy. Traf. Safety Administration

J. C. Fell

Reference copy only

*Head restraints, *Restraints system effectiveness, *Head restraint caused injuries, *Accident studies, *Injury rates, *Whiplash injuries, *Injury severity, *Sex factors, *Rear end collisions, *Front end collisions, *Front seat passengers, *Rear seat passengers, *Driver injuries, *Passenger injuries, *Secondary collisions, *Automated accident records, *Multidisciplinary teams,

To evaluate the effectiveness of head restraints, the neck injury incidence of front seat occupants exposed to head restraints versus those occupants not exposed to head restraints in rear end collisions, and the injury incidence of rear seat occupants who struck head restraints versus those rear seat occupants who did not strike exposed head restraints versus those rear seat occupants who were not exposed to head restraints in frontal collisions were examined using data from a University of

Investigation (MDAI) file. The MDAI rear end cases did not show any apparent reduction in whiplash injuries due to the presence of head restraints. In frontal collisions, the MDAI data indicated that contacts with head restraints and associated injuries were comparable to or less severe than those with the seat back or side interior, the leading contact areas.

HS-820 259

5R. Steering Control Systems

MEASUREMENT OF INERTIAL PROPERTIES AND SUSPENSION PARAMETERS OF HEAVY HIGHWAY VEHICLES

Michigan Univ. Hwy. Safety Res. Inst.

C. B. Winkler SAE-730182

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Commercial vehicles, *Vehicle center of gravity, *Inertia, *Yaw, *Pitch, *Roll, *Moments of inertia, *Measuring instruments, *Suspension system spring rates, *Coulomb friction, *Deflection, *Rear suspension systems, *Front suspension systems, *Vehicle weight, *Equations, *Test equipment, *Heavy duty vehicles,

The large size of commercial highway vehicles can lead to significant problems in determining their inertial and suspension properties. New techniques and equipment were developed to solve these problems. Simple and inexpensive techniques, applicable to inertial testing of bare frame vehicles, are discussed. The use of additional equipment employed in determining the inertial properties of heavy vehicles fitted with bodies is explained. Application of the large forces required to produce significant spring deflection in the suspensions of commercial vehicles introduces problems not found in passenger vehicle testing. Some techniques used to solve these problems are presented. Vertical spring deflection behavior, including coulomb friction, for the suspensions of a truck, tractor, and semitrailer are given.

HS-012 957

5T. Trucks And Trailers

SHOCK INDEX CLASSIFICATION FOR HIGHWAY VEHICLES

R. Kennedy

Sponsored by Hwy. Res. Board Com. on Vehicle Characteristics and Special Com. on International Cooperative Activities.

See serial citation

*Freight transportation, *Vibration protection, *Shock (mechanics), *Severity indexes, *Vehicle riding qualities, *Loading (mechanical), *Suspension systems, *Freight restraint systems, *Road surfaces, *Road tests, *Mathematical analysis,

The shock index classification for highway vehicles is an empirical relation among the static mechanical characteristics of the vehicle and the low frequency shocks transmitted to the cargo. It is intended to be a user guide for shock transmitted to the cargo during transportation. The formulas and methodology for obtaining the index are presented. The first planned use is for

vehicle cushioning and cargo fragility. Cargoes whose loss costs are small compared to added vehicle cushioning costs will also be balanced for optimum economics when the index ratings are known. A comprehensive program will extend the same concept to all modes. Shock indexes or similar empirical factors will be developed for classifying highway pavements with regard to shock which they transmit.

HS-012 932

A DIGITAL COMPUTER METHOD FOR THE PREDICTION OF BRAKING PERFORMANCE OF TRUCKS AND TRAILOR-TRAILERS

Michigan Univ. Hwy. Safety Res. Inst.
For primary bibliographic entry see Fld. 5A.
HS-012 956

MEASUREMENT OF INERTIAL PROPERTIES AND SUSPENSION PARAMETERS OF HEAVY HIGHWAY VEHICLES

Michigan Univ. Hwy. Safety Res. Inst.
For primary bibliographic entry see Fld. 5R.
HS-012 957

5V. Wheel Systems

EFFECTIVENESS OF TIRES UNDER WINTER DRIVING CONDITIONS

R. W. Smith D. J. Clough
Sponsored by Canada Safety Council in cooperation with Ottawa Ministry of Transport, Quebec (Province) Ministère de la Voirie, and Ontario Dept. of Transp. and Communications. Includes discussion by E. Southern.
See serial citation

*Tire performance, *Snow tires, *Studded tires, *Tire chains, *Bias belted tires, *Winter driving, *Icy road conditions, *Snow, *Wet road conditions, *Wheel locking, *Stopping distance, *Tire tests, *Skid resistance tests, *Tire traction, *Sand, *Lane changing, *Thermal factors, *Tire studs, *Test equipment, *Speed,

The effectiveness in winter of snow tires with studs, without studs, and with controlled protrusion studs; elastomeric tire attachments and reinforced steel tire chains; and standard bias belted highway tires is compared. Correlations between each wheel combination and temperature variation were obtained for each set of tests for the following conditions: locked wheel stopping from 35 mph on clear ice, sanded ice, and wet asphalt; breakout speed on a course designed to simulate a lane-change maneuver on clear ice; and starting traction on clear ice and packed snow.
HS-012 936

NEW TIRE-STUD DEVELOPMENTS

R. Cantz
See serial citation

*Tire stud design, *Studded tires, *Tire skid resistance, *Tire performance, *Pavement wear, *Coefficient of friction, *Wear tests, *Simulators, *Tire road contact forces, *Tire design, *Icy road conditions, *Wet road conditions, *Dry road conditions, *Tire pavement interface, *Stopping distance, *Pavements,

Tests of recently developed tire stud designs indicate that the safety and convenience factors of studded tires can be retained while considerably reducing the amount of road wear caused by their use. In addition to a reduction in weight and minor dimensional changes, most of these new tire studs are designed with a built-in stud protrusion-adjustment capability, which is unaffected by differences in wear resistance of various rubber compounds, driving speeds, or road surfaces traveled. Tires fitted with these new studs show an increase of 75% in coefficient of friction on smooth ice as compared to identical tires without studs. Coefficient of friction decreases only about 5% with such studded tires on bare concrete roads. No difference at all in performance between studded and unstudded tires has been found on bare bituminous pavement.

HS-012 937

STUDDED TIRE EFFECTS ON PAVEMENTS AND TRAFFIC SAFETY IN MINNESOTA

C. K. Preus
See serial citation

*Studded tires, *Pavement wear, *Minnesota, *Tire performance, *Accident studies, *Repair costs, *Pavement tests, *Wear tests, *Concrete pavements, *Asphalt pavements, *Road materials, *Vehicle control, *Winter driving, *Road conditions, *Pavement condition, *Skidding accidents, *Accident prevention, *Laboratory tests, *Field tests,

In response to the 1969 Minnesota legislature's directive, several studies of studded tire effects were conducted. The studies included field observations and pavement wear measurements by the Minnesota Highway Department, laboratory pavement wear tests performed by the American Oil Company, and the studded tire safety effectiveness study conducted by Cornell Aeronautical Laboratory. This report supplements and updates information previously reported on these studies. In general, it was concluded that the benefits of studded tires do not outweigh the disadvantages and the funds that would ultimately have to be expended for repair or prevention of road damage caused by the continued use of studs and the year round road hazards they create could be more productive of safety for all motorists if utilized for construction of new and safer roads or for safety improvements on existing roads.
HS-012 938

MECHANICAL PROPERTIES OF TRUCK TIRES

Michigan Univ. Hwy. Safety Res. Inst.
J. T. Tielking P. S. Fancher R. E. Wild SAE-730183
Presented at International Automotive Engineering; Congress, Detroit, 8-12 Jan 1973.
SAE

*Truck tires, *Tire mechanics, *Tire load limits, *Tire inflation pressure, *Tire sizes, *Tire tread patterns, *Tire wear, *Tire traction, *Tire spring rates, *Tire tests, *Tire test equipment, *Data acquisition, *Tire road contact forces, *Lateral force, *Camber, *Cornering, *Tire slip motion, *Tire deflection, *Nylon tires, *Dual tires, *Laboratory tests, *Flow charts, *Stiffness,

Mechanical properties have been obtained from a series of truck tire tests using the Highway Safety Research Institute's flat bed tire testing machine. In addition to the vertical and lateral spring rates, a set of three parameters characterizing

VEHICLE SAFETY—Field 5
Wheel Systems—Group 5V

on properties of the rolling tire are defined and measured. Influence of tire load and inflation pressure on mechanical properties is significant. Carpet plots of lateral force versus tire steering variables such as camber and slip angle are used to illustrate the effect of changes in ply rating, tread pattern, and corresponding variations in the mechanical properties are presented. The results of an experiment to determine the relationship between single tire and dual tire force and moment produc-

ing capabilities are presented.
HS-012 958

STOPPING-DISTANCE ANALYSIS

Bendix Corp.

For primary bibliographic entry see Fld. 5A.
HS-012 963

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

Office of Administration
WASHINGTON, D.C. 20590
OFFICIAL BUSINESS
Penalty For Private Use, \$300

CARNEGIE LIBRARY

OCT 1 1973

OF PITTSBURGH

POSTAGE AND FEES PAID
NATIONAL HIGHWAY TRAFFIC SAFETY
ADMINISTRATION

517

